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ABSTRACT

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Circumstances which Facilitate Children's Recognition of Moving People[1]

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An abridged version of this paper was presented at the Biennial Meeting of the Society for Research in Child Development, New Orleans, March 1977.

Abstract

Three experiments investigated children's recognition of moving, active people. Experiments 1 and 2 found that young children (and preschoolers in particular) had considerable difficulty in recognizing a videotaped person who initially performed a single 10-sec activity and then reappeared with a different activity and/or different hair style. The children's performance was poor even when minor idiosyncracies in style of movement were potentially available as a basis for distinguishing target people from novel comparison people. Given the current 10-sec, single-activity presentations, Ss apparently do not use these idiosyncracies as a basis for recognition.

Children's recognition of moving people was facilitated, however, in Experiment 3. In this experiment, 4.7- and 5.8-year olds had better recognition performance if they had initially seen the target person perform three diverse 12-sec activities (which differed between themselves in facial orientation and facial movement), than if they had seen the target person perform three identical 12-sec versions of the same activity. The superiority of performance in the Diverse Activity condition indicates that children's perception of invariant attributes of a target can be facilitated if the child views the target undergoing diverse, ongoing movement-produced transformations over time.

For many years, developmental studies of recognition abilities have focussed heavily on young subjects' recognition of stationary objects, stationary people, and stationary letters. Because stationary stimuli differ in several respects from moving stimuli, however, there are many questions which remain unanswered concerning the recognition capabilities which infants and young children display in their daily lives, where the stimuli are often moving people and moving objects.

Some of the potential differences between moving and stationary stimuli are that moving stimuli, in contrast to stationary stimuli: (1) Undergo ongoing changes in orientation and position, (2) Usually look different in several respects (e.g. in orientation, position, type of movement, dress, or hair style) on different occasions, and (3) May be capable in some cases of exhibiting individualistic styles or patterns of movement.

How might these three attributes affect young subjects' recognition of the target object? Let us consider for a moment some hypothetical extremes. If young subjects' perceptual abilities were particularly well-adapted to recognizing identical instances of a given object, and subjects had difficulty in extracting invariant information over changing circumstances, then of course movement would impair recognition. The subject would perceive that the object was "really different" whenever it underwent movement-produced changes in its position, orientation, appearance, etc.

If, on the other hand, young subjects were adept at perceiving invariant attributes over changing circumstances, then movements would not necessarily impair recognition since the subject would realize that the object was the same object despite its various movement-produced changes. In this case, particular

kinds of movement might even facilitate recognition. For example, the subject might conceivably be better able to perceive what the invariant criterial features of the object were, and thus be better able to recognize it, if he had seen it turning in such a fashion that all sides of the object were eventually visible. Similarly, recognition might also conceivably be facilitated if the target object displayed an individualistic style or pattern of movement, i.e. one that was characteristic of that object but not of other objects. In this event, the subjects might pick up the consistencies in the target's style or pattern of movement (e.g. "That person moves rapidly, with small jerks," or "Cats glide but don't bounce") and use these consistencies as a partial basis for recognizing that target and distinguishing it from others.

At the moment, it is difficult to tell if any of these various possibilities actually occurs, or whether young subjects in other words are or are not adept at recognizing moving objects. Experimental findings indicate that young subjects do have difficulty in recognizing invariant attributes of targets that initially appear in stationary presentations and then undergo discrete changes in spatial positioning (Piaget, 1952), facial orientation and facial expression (Saltz & Sigel, 1967; Diamond & Carey, 1977), masks (De Vries, 1969), or dress (Diamond & Carey, 1977). It is not known, however, if young subjects have analogous difficulties in recognizing invariant attributes of objects which are continuously in motion, and which undergo continual, ongoing movement-produced changes. Similarly, although there is good evidence that young subjects are sensitive to certain consistencies in movements -- such as consistencies in rigid vs. non-rigid transformations (Gibson, Johnston, & Owsley, 1977) or in overall temporal patterning (Bower, Broughton, & Moore, 1971) -- it is not known whether young subjects regularly utilize these consistencies as an aid to recognizing and distinguishing one particular moving object from another moving object.

In this paper, several experiments are reported which briefly examine some of these issues. The experiments investigate the extent to which children of different ages are able to recognize moving people who reappear on a different occasion with superficial differences in their appearance or orientation and position (Experiment 1), who exhibit idiosyncratic styles or patterns of movement (Experiment 2), or who initially exhibit a variety of diverse ongoing changes in orientation and facial movement (Experiment 3). It is thought that these experiments can help to clarify the extent to which young subjects are able to recognize moving targets. People were selected here as the targets for recognition both because they are important and commonly-encountered parts of young children's daily experiences, and because they naturally perform a variety of movements. They are thus ideal stimuli for investigating the recognition capabilities which children might bring to bear in the complex naturalistic situations they encounter in their daily lives.

EXPERIMENT 1

Because people perform a variety of different activities in their daily life, they seldom appear identical in all respects to an observer on two different occasions. A person may, for example, be seen on one occasion while performing particular activities. On another occasion, the person may engage in somewhat different activities, and so may display facial orientations and/or facial expressions that were previously not seen by the observer. In addition, differences in the target person's dress and hair style may also occur between the first occasion and the later one.

Experiment 1 selected two of these differences for illustrative purposes -- differences in type of activity and in hair style -- and examined whether these differences impaired subjects' ability to recognize a moving person. The

differences in hair style involved differences between loose hair, braided hair, and hair pinned up out of sight behind the head, while the differences in activity involved differences not only in function (e.g. waving and smiling vs. putting on a coat), but also accompanying differences in facial and bodily orientation, and sometimes facial expression as well.

A series of paired comparison tests were used, wherein subjects ranging in age from four years to adulthood indicated whether the moving person in two videotaped events was the same person or not. The initial 10-sec event in each pair of events showed the head and upper torso of a young woman who was performing a "single" activity such as waving and smiling, eating bread, looking through the pages of a book, or shrugging her shoulders, etc. As this initial event appeared, the target person was named ("This is _____"). Immediately afterwards, there was a 2-sec blank interval, followed by the comparison 10-sec event. The comparison event showed either the initial target person (half the comparisons) or a novel person of the same sex, age, dress, and hair color (half the comparisons) who was performing a given activity. Subjects were asked "Is this (target person's name) or is this someone else?" Each subject was given sixteen such pairs, each of which began with a target person and a type of activity that had not been previously seen in the experiment.

The results in Figure 1, which are taken from a repeated measures design, indicate that there were no differences in adjusted recognition scores[2] across the five age groups (4.6 years, 6.1 years, 9 years, 12 years, and adult) in cases where the target person reappeared in the comparison event with the same hair style she had previously had, and performed the identical same activity she had previously performed (chi-square test for age differences in this condition: $\underline{X}^2 = 0.13$, df 4, $\underline{p} > .05$). As can be seen from the top line in the graph in Figure 1,

recognition performance was nearly at ceiling at all ages in this "unchanged" condition.

There were, however, marked differences between the various age groups in the cases involving different activities ($\underline{X}^2 = 20.49$, df 4, $\underline{p} < .001$), different hair styles ($\underline{X}^2 = 19.31$, df 4, $\underline{p} < .001$), and both different activities and different hair styles together ($\underline{Y}^2 = 12.41$, df 4, $\underline{p} < .02$). As indicated in Figure 1, these age differences arose because the younger subjects failed to recognize the target person when she reappeared with a different hair style and/or different activity. This suggests that the younger subjects were unable to extract invariant attributes of the person's appearance and depended instead on what might be called situation-specific aspects of her appearance as a basis for recognition. These situation-specific aspects included attributes of hair style, as well as attributes that presumably dealt with the appearance of the face from a particular orientation or with a particular expression.

EXPERIMENT 2

Because young children's recognition performance was for the most part extremely poor in the previous experiment, it seemed important to ascertain if there were conditions which might facilitate recognition.

Experiment 2 accordingly explored whether idiosyncracies in style of movement might facilitate recognition. In the preceding experiment, there were no idiosyncracies in style of movement, since all of the videotaped people had followed a prescribed "script" for each activity which specified their head orientations at various moments, their hand and bodily positions, and their overall tempo of movement. In other words, there were no between-person differences in style of movement.

It seemed conceivable, however, that this procedure might have accidentally

eliminated a valuable source of information. Because young subjects easily detect consistencies and differences in movement patterns -- including consistencies and differences in tempo, patterning, or rigidity and non-rigidity of movement (Gibson, Johnston, & Owsley, 1977; Bower, Broughton, & Moore, 1971) -- recognition might conceivably have been markedly improved in conditions where target and comparison people exhibited differing movement patterns, or differing styles of movement.

In order to investigate this possibility, Experiment 1 was therefore replicated, but this time the target and comparison people were permitted to utilize their own preferred style of movement. As a result, when two people performed the "same" activity, their performances were not identical. For example, one person might wave and smile in a more wooden fashion than her matched comparison, or one person might move in a more rapid fashion than her counterpart.

Unfortunately, the between-person differences in movement patterning which were thereby introduced did not seem to be of any help to the subjects who were participating in the recognition task. Figure 2 plots the results obtained in the replication (where the target and comparison people, and type of activities, and subject population[3] were all identical to that employed in Experiment 1). As shown in Figure 2, young subjects were still markedly unsuccessful in recognizing target people and distinguishing them from their matched comparisons. Detailed analyses of adjusted recognition scores, raw hits, and raw false alarms, as well as developmental trends, all indicated that performance was in fact no better in Experiment 2 than in Experiment 1.

It may be, of course, that consistencies in style or pattern of movement are utilized in situations where familiar people are involved, or where lengthy exposure durations occur. The current results, however, suggest that young

subjects apparently do not utilize minor idiosyncracies in style of movement as a basis for recognizing and distinguishing strangers who appear in 10-sec presentations.

EXPERIMENT 3

So far we have been looking briefly at two attributes of moving people -- their capacity to reappear on different occasions with superficial changes, and their capacity to display idiosyncratic or individualistic patterns or styles of movement. Experiment 3 examines a third attribute of moving people (and moving stimuli in general) -- namely, their capacity to undergo continuous ongoing changes in orientation and position.

It seems important to distinguish conceptually between changes which occur between one presentation and another (which were investigated in Experiment 1) and ongoing changes which occur as the observer looks at the target person (which Experiment 3 will focus on). In cases where two separate presentations are involved (i.e. when there is an intervening period when the target person is not in sight), the observer does not know in advance who he will see during the later presentation. The observer's task is in fact to "figure out" if the later person is the same person as the earlier person.

This differs from what happens during ongoing changes however (i.e. cases where the target person remains in view while moving or changing superficially). In this latter case, because the target remains in sight and its surface is not occluded, the viewer has visible evidence that the particular target person is "still there." The observer's task in this case then is <u>not</u> to "figure out" if the person appearing at later moments is the same person that appeared at earlier moments; instead the task becomes one of simply noticing or observing how the target person looks over a variety of circumstances.

These considerations then, suggest that ongoing changes may have a different

effect on subjects' perception and recognition than changes which occur between one presentation and another. In fact, there are reasons for hypothesizing that ongoing changes may actually facilitate subjects' accurate perception and recognition of physical attributes of the moving person. Eleanor Gibson (1969) and James Gibson (1966) have hypothesized for example that subjects will be best able to pick up criterial or identifying features of an object when they view that object undergoing diverse, movement-produced transformations over time. For example, information about an object's shape in depth (e.g. its particular protuberances or indentations) as well as information about its angularity, curvature, and rigidity and non-rigidity of form are said to be optimally available in circumstances where the target object (or the observer) moves in such a way that different sides of the object continuously come into the observer's field of view, and different spatial arrangements of the object's parts continuously become visible.

Are the Gibsons correct in assuming that ongoing movement-produced changes can help subjects to extract information concerning the unchanging physical attributes of the target? In order to obtain data on this point, and to investigate the effect of diverse ongoing changes on recognition performance, Experiment 3 tested subjects for their recognition of moving people who had initially undergone either diverse or less-diverse movement-produced transformations. Figure 4 illustrates the nature of the stimuli. Half of the subjects at each of three age levels (4.7 years, 5.8 years, and adult) were assigned to a Diverse Activity condition. These subjects would initially see a target person who was, for example, identified verbally as "Steve." Steve was shown for 12 seconds while sipping water from a cup through a straw, for 12 more seconds while measuring a box with a ruler, and for 12 more seconds while scratching his head. There were differences in facial movement and facial orientation between

the three activities, and at least two different facial expressions.

The other half of the subjects at each age level were assigned to a Single Activity condition. These subjects saw the target "Steve" for the same total amount of time as the Diverse Activity subjects, but they saw the target undergoing a less varied set of ongoing facial movements. This was accomplished by showing the subjects three identical repetitions of the single activity of "Steve scratching his head."

Following these initial presentations, all subjects -- Diverse Activity as well as Single Activity subjects -- were then tested for their recognition of Steve. After a 2-sec blank interval, they saw a new event (e.g. a person putting on a coat) which involved either Steve or another person of the same sex and hair color and hair style and hair length as Steve, and the subjects were asked "Is this Steve or is this someone else?"

A series of twelve such tests were given to each subject. Each of these tests began with a new target person who was named, and with a new set of activities. The results from these tests, which are presented in Figure 3, indicate that there was a significant age-by-condition interaction. Specifically, recognition was better in the Diverse Activity condition than in the Single Activity condition for 4.7-year-olds ($p < .001$) and 5.8-year-olds ($p < .005$) but not for adults. These results show that young children's recognition of moving people can be facilitated if the children have prior opportunity to view the target person performing a diverse series of movements, which involve diverse ongoing perspective changes and diverse ongoing movements of the facial musculature.

DISCUSSION

The current experiments indicate that successful visual recognition is by no means perfected by the time the young child enters pre-school or kindergarten.

Instead, children continue to develop throughout the pre-school and school-age years in their ability to recognize unfamiliar moving people who undergo superficial changes in their appearance or behavior.

Perhaps the most interesting part of this developmental process, though, occurs early on with 4- to 6-year old children. The pre-schoolers are to some extent able to recognize moving people who reappear on different occasions with different facial orientations and different facial and bodily movements. The children do not do so in all circumstances, however, and they seem reasonably adept at this only in cases where the moving person has initially been seen to perform a variety of diverse movements. Apparently, this opportunity to see the target face undergoing diverse ongoing perspective transformations, and diverse ongoing changes in the facial musculature, facilitates extraction of invariant facial features. In summary then, ongoing movement-produced changes thus provide ideal circumstances for the extraction of unchanging physical attributes of the moving target.

These findings provide certain clues as to what young children's perception and recognition may be like in daily life. It seems likely that a person's or object's or animal's diverse movements probably do not "distract" the child from attending to the physical attributes of that person, object, or animal. Instead, the diverse movements may help the child to learn what the invariant physical attributes of that item are, and they may thus make it possible for the child to accurately perceive and recognize a large number of the people, objects, and animals which he encounters in his daily life. This suggests that perception and recognition may be most accurate in "real-life" circumstances -- where an observer's movement or a target's movement produce continual ongoing perspective changes and non-rigid transformations -- and least accurate in "laboratory" situations involving stationary photographs or targets which undergo brief, non-diverse movements.

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Footnotes

[1]The experiments described in this paper were reported in the author's doctoral dissertation at Cornell University. I am especially grateful to my thesis chairman, Dr. Eleanor Gibson, for her many, many helpful comments on this research. Thanks are also due to the children and teachers at the Enfield Elementary School, the Country Playschool, the Ithaca Area Church and Community Day Care Center, and the South Hill Child Care Center, all in Ithaca, New York. Research support was provided by a National Institute of Mental Health Pre-Doctoral Traineeship (#5-T01-MH08520). Requests for reprints can be sent to: Dr. Jean Dirks, University of Michigan, Mason Hall, Psychology Department, Ann Arbor, Michigan, 48109.

[2]Statistical analyses in all three experiments utilized adjusted recognition rates. These were calculated separately for each age level and condition by adjusting the correct recognitions of target people (hits) in proportion to the false recognitions of unfamiliar people (false alarms) according to this formula from Green & Swets (1966):

$$\text{Adjusted recognition rate} = \frac{\text{Hit rate} - \text{False Alarm rate}}{1 - \text{False Alarm rate}}$$

[3]Within a given day-care center or classroom, children were randomly assigned to Experiment 1 and Experiment 2.

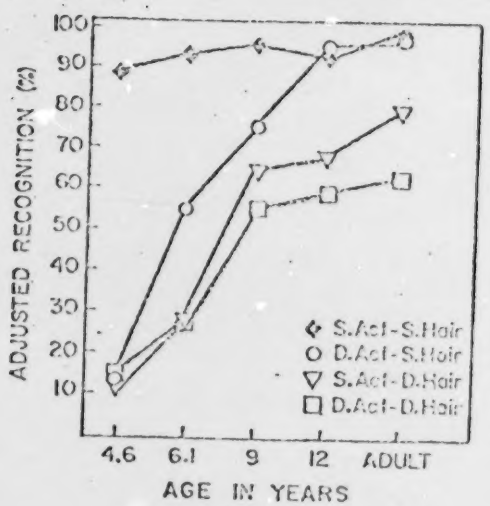

FIGURE 1: ADJUSTED RECOGNITION SCORES IN EXPERIMENT 1

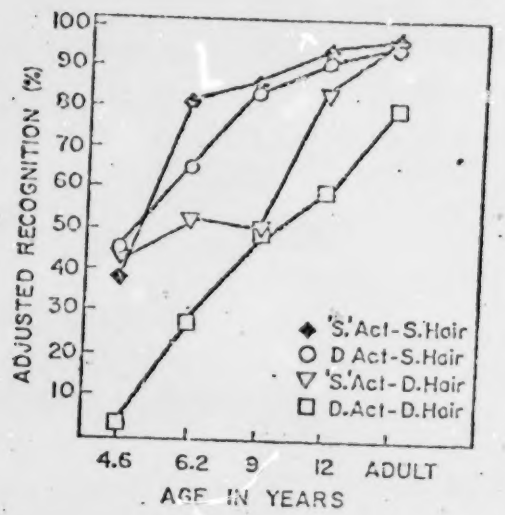

FIGURE 2: ADJUSTED RECOGNITION SCORES IN EXPERIMENT 2

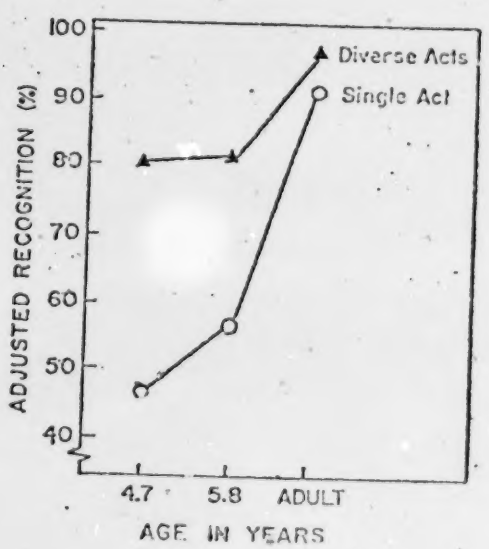

FIGURE 3: ADJUSTED RECOGNITION SCORES IN EXPERIMENT 3

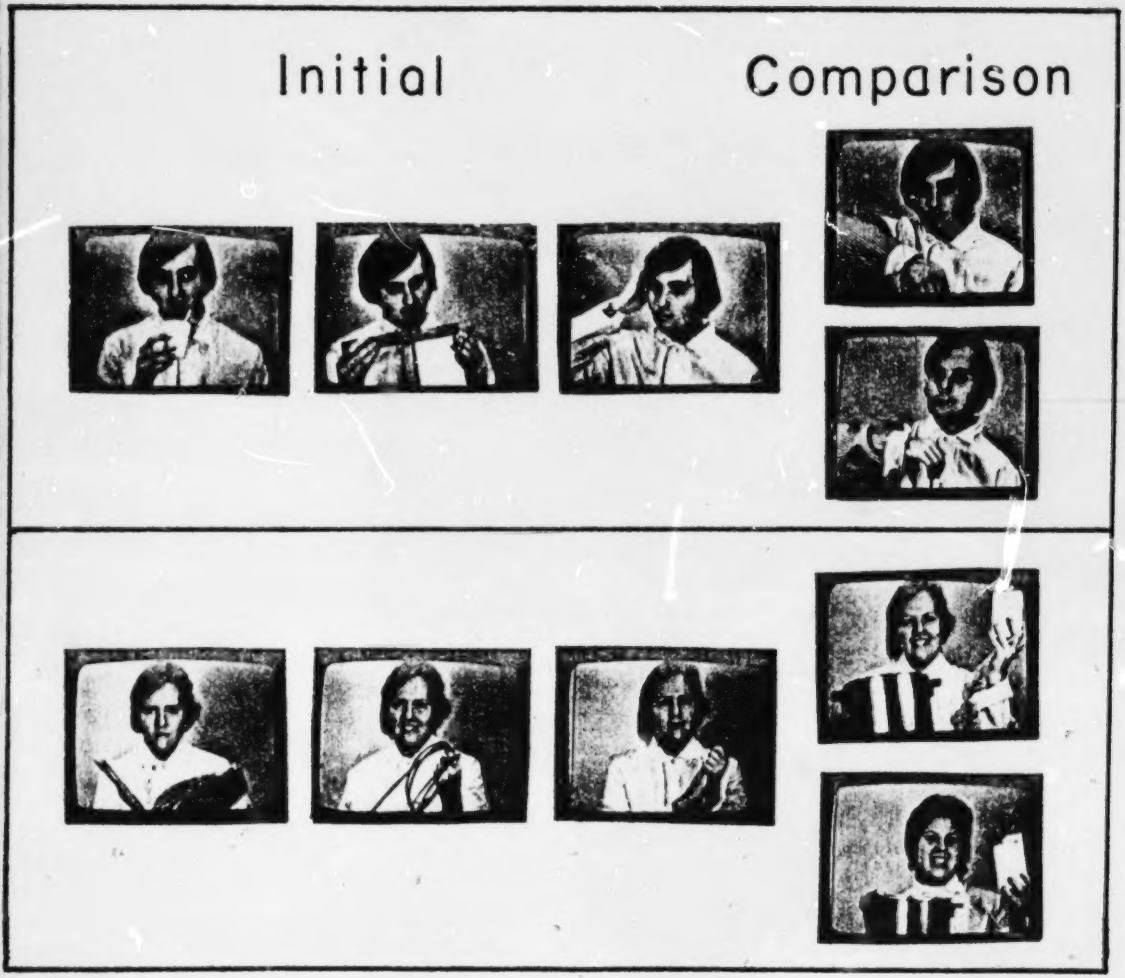

FIGURE 4: SAMPLE PICTURES TAKEN FROM DIVERSE ACTIVITY CONDITION IN EXPERIMENT 3